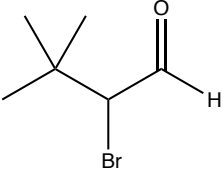




1 Complete the table below. (2)

Skeletal structure		
Name		2-methylpentan3-one

2 a Write a balanced equation for each of the following reactions.

i propanal + Tollen's reagent (2)

ii propanone + NaBH₄ (2)

iii butanone + acidified KCN (2)

b i Name and outline the mechanism for reaction iii. (5)

ii Explain why the product of reaction iii is optically inactive.

.....

.....

.....

.....

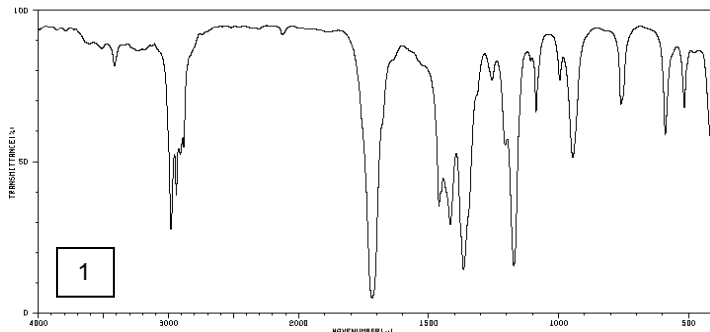
.....

..... (3)



The IR spectra of the five compounds listed are shown. Identify the compound and give the wavenumber and bond type for the key signals that helped you identify that compound.

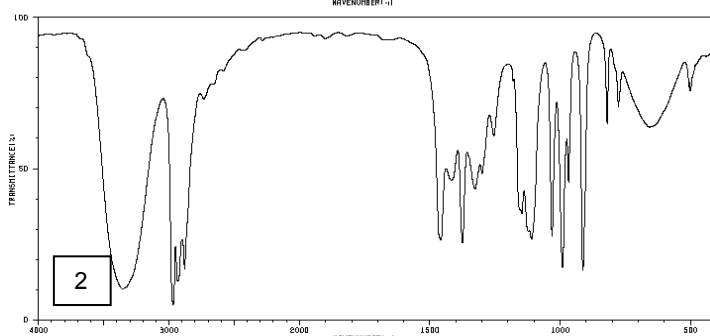
butanoic acid, butanone, butan-2-ol, 2-methylbut-1-ene, butylamine



Compound

Bond & range (cm⁻¹)

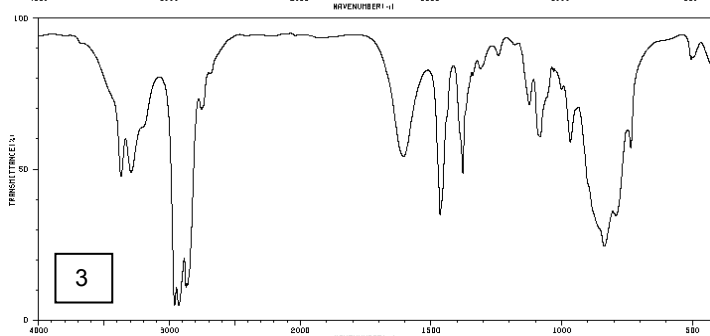
Bond & range (cm⁻¹)



Compound

Bond & range (cm⁻¹)

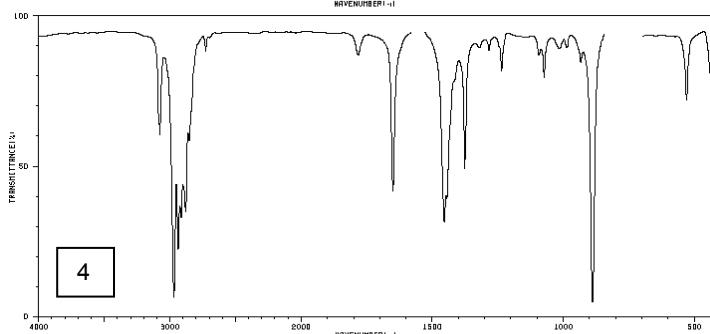
Bond & range (cm⁻¹)



Compound

Bond & range (cm⁻¹)

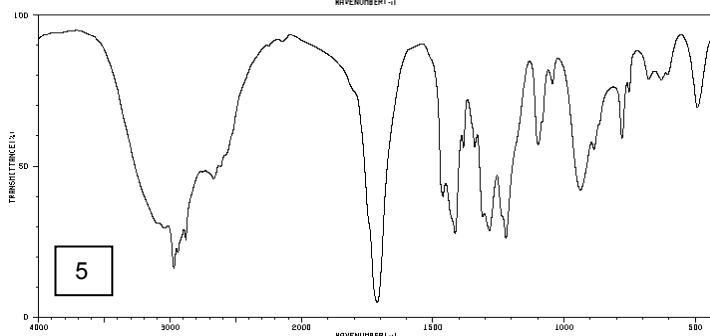
Bond & range (cm⁻¹)



Compound

Bond & range (cm⁻¹)

Bond & range (cm⁻¹)



Compound

Bond & range (cm⁻¹)

Bond & range (cm⁻¹)



1 a What would you see when colourless chlorine water is added drop-wise to colourless aqueous potassium iodide?

.....

b Write an ionic equation for the reaction taking place.

c What does this tell you about the oxidising power of chlorine relative to iodine, and explain why one has greater oxidising power than the other.

.....
.....
.....
.....

2 Silver nitrate solution was added to an acidified solution of a compound containing a halide ion. A cream precipitate formed that re-dissolved when concentrated ammonia was added.

a Explain why the solution is acidified before silver nitrate is added.

.....
.....

b Identify a suitable acid for this.

c Identify the halide ion in the compound.

d Write an ionic equation for the formation of the cream precipitate.

.....

e Write an ionic equation for the reaction of the cream precipitate with concentrated ammonia.

.....



a Describe and explain the trend in ionisation energy down group 2.

.....
.....
.....

b Explain why strontium has a lower melting point than calcium.

.....
.....
.....

c What would you see in each of the following reactions? If there is a reaction, write the simplest ionic equation.

addition of aqueous potassium sulfate to aqueous magnesium nitrate

.....
.....

addition of aqueous sodium hydroxide to aqueous magnesium nitrate

.....
.....

d Sulfate ions in aqueous solution can be tested for using acidified barium chloride. Why is acid added before the barium chloride solution and identify a suitable acid.

.....
.....
.....
.....
.....

e Write an equation and give observations for the reaction of magnesium with steam.

.....
.....
.....

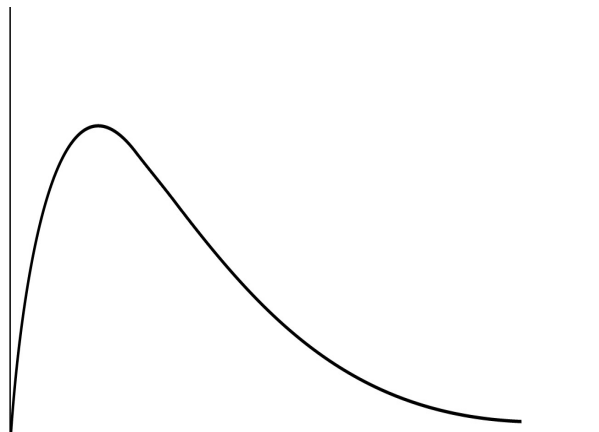
f Write an equation and give observations for the reaction of calcium with water.

.....
.....
.....



1 The Maxwell-Boltzmann distribution is shown for the particles in a gas at temperature T_1

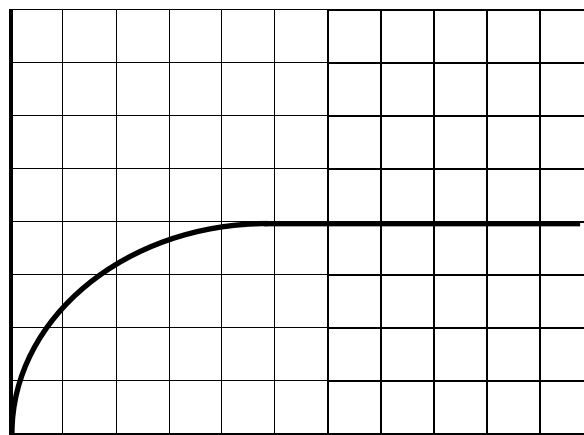
- a Label both axes.
- b Mark the most probable energy of the molecules at T_1 (label this E_{mp1})
- c Sketch another distribution to show the same sample at a lower temperature T_2
- d Mark the most probable energy of the molecules at T_2 (label this E_{mp2})



2 Magnesium reacts with hydrochloric acid to form hydrogen gas. A graph is shown showing the volume of hydrogen varies with time when 25 cm³ of 0.500 mol dm⁻³ reacts with an excess of magnesium at 20°C.

- a Sketch a line to show how the volume of hydrogen changes if a similar reaction was carried out but with 50 cm³ of 0.250 mol dm⁻³ (label this **A**)
- b Sketch a line to show how the volume of hydrogen changes if a similar reaction was carried out but with 25 cm³ of 0.750 mol dm⁻³ at 40°C (label this **B**)

Volume of H₂



c Define the term *rate of reaction*.

.....

d Explain why rate of reaction increases with concentration.

.....

.....

e Explain why rate of reaction increases with temperature.

.....

.....

.....



FREE RADICAL SUBSTITUTION

Ethane reacts with chlorine in the presence of uv light to form a mixture of halogenoalkanes.

- 1 Write an equation for the initiation step.
- 2 What is the uv light for?
.....
.....
- 3 Two of the products in this reaction are chloroethane and 1,1-dichloroethane.
 - a Write a balanced equation for the reaction of chlorine with ethane to form chloroethane.

 - b Write a balanced equation for the reaction of chlorine with ethane to form 1,1-dichloroethane.
- 4 One of the products from this reaction is chloroethane. Write a pair of propagation steps to form chloroethane from ethane.

- 5 One of the products from this reaction is 1,1-dichloroethane. Write a pair of propagation steps to form 1,1-dichloroethane from chloroethane.

- 6 What would be the product of the reaction of ethane with a large excess of chlorine in the presence of uv light?

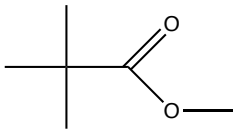
- 7 Some 1,2-dichloroethane can be formed in a termination step. Write an equation to show how this can happen.



ORGANIC NOMENCLATURE B

Complete the tables below.

Structure	Name
$\text{H}_3\text{C}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\overset{\text{CH}_3}{\underset{ }{\text{CH}}}-\text{CH}_3$	
$\text{CH}_3-\text{CH}_2-\overset{\text{OH}}{\underset{ }{\text{CH}}}-\overset{\text{I}}{\underset{ }{\text{CH}}}-\overset{\text{CH}_3}{\underset{\text{CH}_3}{\underset{ }{\text{C}}}}-\text{CH}_3$	
	4-bromo-3-fluoropent-2-ene
	4,4-dimethylpentanal

Skeletal formula	Displayed formula
	
	$\begin{array}{ccccccc} & & \text{H} & & & \text{O} & \\ & & & & & & \\ & \text{H} & \text{C} & \text{H} & & & \\ & & & & & & \\ \text{H} & -\text{C} & -\text{C} & =\text{C} & -\text{C} & -\text{C} & -\text{H} \\ & & & & & & \\ & \text{H} & \text{H} & \text{H} & \text{H} & & \\ & & & \text{Br} & & & \end{array}$



Complete the tables below.

Structure	Name
$\begin{array}{ccccccc} & & & \text{CH}_3 & & & \\ & & & & & \text{CH}_3 & \\ & & & \text{CH}_2 & & & \\ & & & & & \text{CH} & \\ \text{CH}_3 & - & \text{CH}_2 & - & \text{CH} & - & \text{CH} & - & \text{CH}_3 \end{array}$	
$\begin{array}{ccccccc} & & \text{CH}_3 & & \text{CH}_3 & & \\ & & & & & & \\ \text{H}_3\text{C} & - & \text{CH} & - & \text{C} & - & \text{CH} = \text{CH} & - & \text{CH}_3 \\ & & & & & & \\ & & & & \text{CH}_3 & & \end{array}$	
	2,3-dimethylpentane
	methylpropene

Skeletal formula	Displayed formula
	$\begin{array}{cccccccc} & & & \text{H} & & & & & \\ & & & & & & & & \\ & & \text{H} & - & \text{C} & - & \text{H} & & \\ & & & & & & & & \\ \text{H} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & = & \text{C} & - & \text{H} \\ & & & & & & & & & & & & & & \\ & & \text{H} & & \text{H} & & \text{H} & & \text{H} & & \text{Br} & & & & \end{array}$



CALCULATIONS (B)

- 1 In what molar ratio do the following substances react?
- a sulfuric acid acid with barium hydroxide (1)
- b nitric acid with potassium carbonate (1)

- 2 Write an ionic equation, including state symbols, for each of the following reactions.
- a reaction of aqueous ammonia with hydrochloric acid
..... (2)
- b precipitation of lead(II) bromide when aqueous lead(II) nitrate is mixed with aqueous sodium bromide
..... (2)

- 3 Deduce the limiting reagent and calculate what mass of magnesium oxide is formed when 486 mg of magnesium reacts with 240 mg of oxygen.
- $$2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$$
-
.....
.....
.....
..... (4)

- 4 What is the atom economy to make tungsten in this reaction: $\text{WO}_3 + 3\text{H}_2 \rightarrow \text{W} + 3\text{H}_2\text{O}$
-
.....
.....
.....
..... (2)



1 Give the full electron configuration of the following atoms and ions.

a F atom (1)

b V atom (1)

c V^{3+} ion (1)

2 Write an equation, including state symbols, to represent the following ionisation energies:

a 1st ionisation energy of potassium (1)

b 2nd ionisation energy of potassium (1)

3 Which group is the following element in? (1)

Ionisation energy	1st	2nd	3rd	4th	5th	6th	7th	8th
kJ mol^{-1}	1310	3390	5320	7450	11000	13300	71000	84100

4 Which element in each of the following pairs has the highest 1st ionisation energy? Explain your answer in each case.

a Na or Mg
.....
.....
..... (3)

b P or S
.....
..... (3)

c Ne or Ar
.....
..... (3)

d Be or B
.....
..... (3)



1 a Identify the particle that contains two more protons, two fewer neutrons and the same number of electrons as an atom of ${}^{54}_{24}\text{Cr}$.
..... (1)

b What difference, if any, is there in the chemical properties of the isotopes ${}^{79}_{35}\text{Br}$ and ${}^{81}_{35}\text{Br}$. Explain your answer.
.....
.....
..... (2)

2 a Give the full electron configuration of the following atoms and ions.
P atom (1)
 Ni^{2+} ion (1)

b Complete electron configuration of the following atoms and ions.
Cu atom [Ar] (1)
 Cr^{3+} ion [Ar] (1)

3 a Find the mass of one atom of ${}^{19}_9\text{F}$ in kg given the following data. Give your answer to the appropriate number of significant figures.
mass of electron = 9.1094×10^{-31} kg
mass of proton = 1.6726×10^{-27} kg
mass of neutron = 1.6749×10^{-27} kg
.....
..... (2)

b Find the mass of one mole of atoms of ${}^{19}_9\text{F}$ in kg. Give your answer to the appropriate number of significant figures.
Avogadro constant (L) = 6.022×10^{23}
.....
..... (1)



Nitrogen reacts with hydrogen as shown: $3\text{H}_2(\text{g}) + \text{N}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g}) \quad \Delta H = -76 \text{ kJ mol}^{-1}$

10.0 moles of hydrogen was mixed with 5.0 moles of nitrogen. At equilibrium, there was found to be 3.0 moles of ammonia. The total pressure was $2.0 \times 10^7 \text{ Pa}$.

a Write an expression for K_p for this equilibrium.

.....

b State the units of K_p

c Calculate the moles of hydrogen and nitrogen at equilibrium.

hydrogen = nitrogen =

d Calculate the partial pressure of each gas.

hydrogen = nitrogen = ammonia =

e Calculate K_p for this equilibrium.

.....

.....

.....

.....

f Explain what would happen to the position of the equilibrium and the value of K_p if the total pressure of gases was decreased?

.....

.....

.....

.....

g Explain what would happen to the position of the equilibrium and the value of K_p if the temperature of gases was decreased?

.....

.....

.....

.....



1 Magnesium oxide is formed when magnesium reacts with oxygen.

a Write an equation for this reaction.

b Describe what you would see in this reaction.

.....

c Write an equation for the reaction of magnesium oxide with water. Give the approximate pH of the solution formed.

equation pH

d Explain why the reaction of sodium oxide reacts with water forms a solution that is more alkaline.

.....

.....

.....

e Write an equation for the reaction of magnesium oxide with nitric acid.

.....

2 Sulfur (IV) oxide is formed when sulfur reacts with oxygen.

a Write an equation for this reaction.

b Describe what you would see in this reaction.

.....

c Write an equation for the reaction of sulfur (IV) with water. Give the approximate pH of the solution formed.

equation pH

d Write an equation for the reaction of sulfur (IV) oxide with potassium hydroxide.

.....

3 In general terms, metal oxides are usually basic and non-metal oxides are usually acidic. Explain this difference in terms of structure and bonding.

.....

.....

.....

.....

.....

4 Write an equation for the reaction of sodium oxide with phosphorus oxide.

.....